

GIT

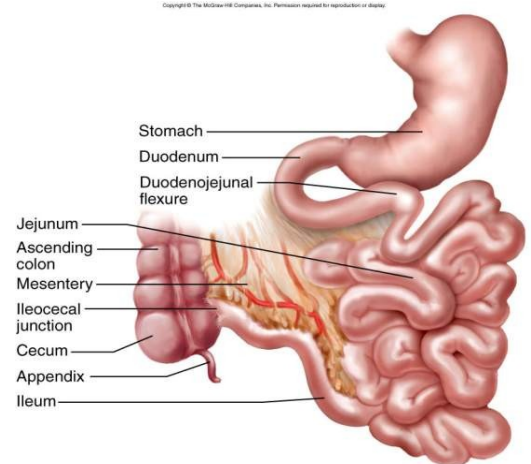
Intestinal Secretion

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ILOs

By the end of this lecture the student will be able to:

1. List composition of intestinal secretion
2. Explain its role in digestion and absorption
3. Compare between their functions
4. Apply knowledge to solve clinical problem



Small Intestine

- Proximal part → Duodenum “Mixing bowl” that receives chyme from stomach and digestive secretions from pancreas and liver to neutralize acids before they can damage the absorptive surfaces of the small intestine.
- Middle part → Jejunum. It is the location of most - Chemical digestion.

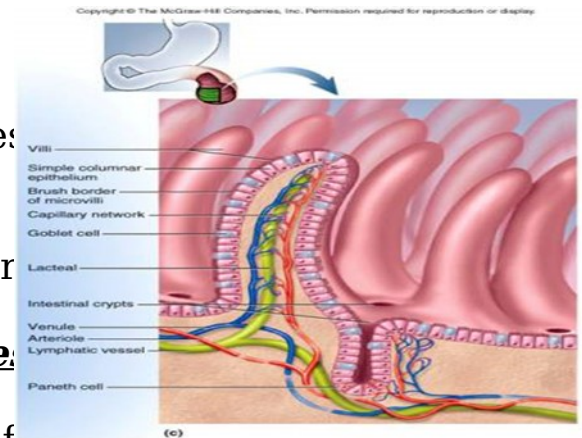
- Nutrient

absorption

- Distal part → Ileum. ?? Site of.....

N.B.: ***Most digestion and absorption happens in small intestine (SI).***

- ❖ Villi contain blood vessels and lymphatics (lacteal) →
 - Nutrient absorption.
- ❖ Microvilli, brush border →
 - Enzymes for final stages of digestion.
- ❖ Enterocytes secrete the enzymes.
- ❖ Many cells in SI secrete different secretions.



Functions of small intestine

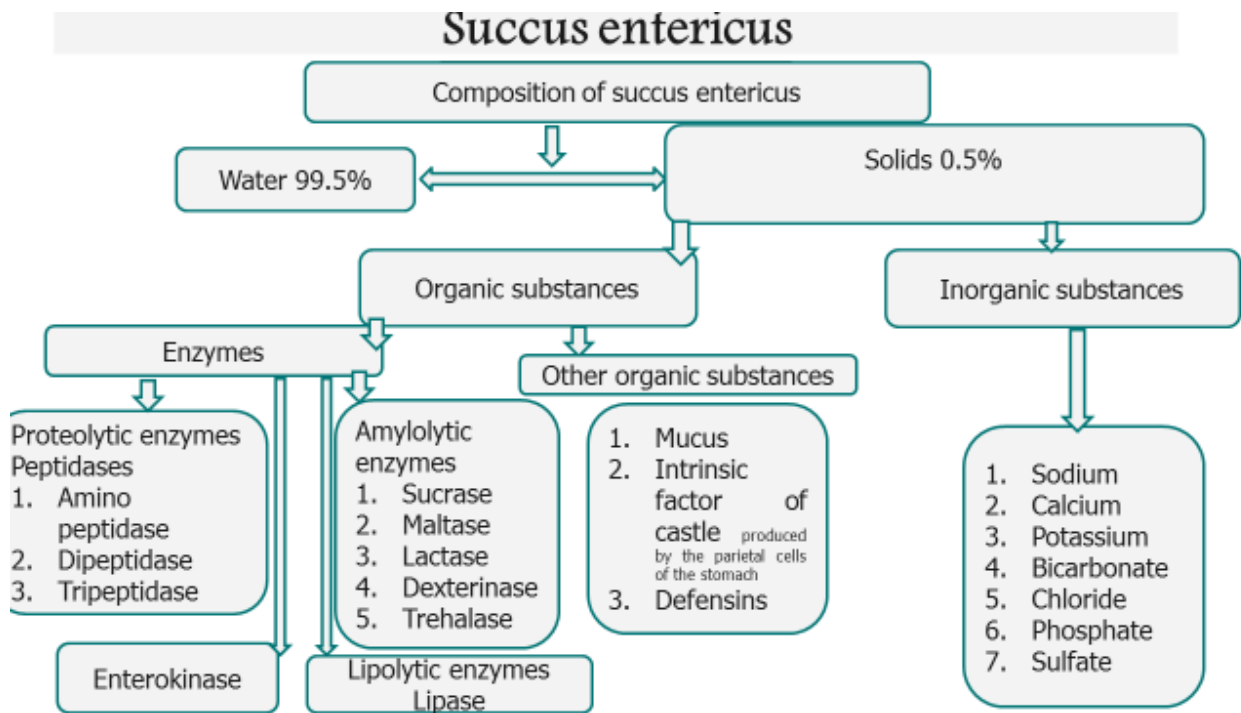
- (1) **Mechanical function:** Mixing movement of the small intestine helps in the thorough mixing of chyme with the digestive juices like succus entericus, pancreatic juice and bile.
- (2) **Secretory and hormonal functions:** SI secretes succus entericus, enterokinase and hormones. Small intestine secretes many GI hormones such as secretin, cholecystokinin, etc. These hormones regulate the movement of GI tract and secretory activities of small intestine and pancreas.
- (3) **Activator function:** Enterokinase activates certain enzymes.
- (4) **Hemopoietic function.**
- (5) **Hydrolytic function.**
- (6) **Digestive function.**
- (7) **Absorptive function.**

Properties of succus entericus:-

Volume: ≈ 1800 mL/day. (+1000).
 ≈ 8.3

Reaction: Alkaline.

pH



Functions of succus entericus:

- (1) Digestive function.
- (2) Protective function.
- (3) Activator function.
- (4) Hemopoietic Function.
- (5) Hydrolytic Function.

Regulation of secretion of succus entericus

Secretion of succus entericus is regulated by both nervous and hormonal mechanisms.

Nervous Regulation

Stimulation of parasympathetic nerves → vasodilatation and increases the secretion of succus entericus.

Stimulation of sympathetic nerves → vasoconstriction and decreases the secretion of succus entericus.

But, the role of these nerves in the regulation of intestinal secretion in physiological conditions is uncertain.

However, the **local nervous reflexes play an important role** in increasing the secretion of intestinal juice. When chyme enters the small intestine, the mucosa is stimulated by physical irritation “by tactile stimuli, distention,..” or/and chemical irritation “by digestive products and acid chyme”. It causes the development of local nervous reflexes, which stimulate the glands of intestine.

Hormonal regulation

When chyme enters the small intestine → (+) “stimulating” intestinal mucosa → secretes enterocrinin, secretin and cholecystokinin → promote secretion of succus entericus by (+) “stimulating” the intestinal glands “.....”.

Digestive and absorptive functions

I- Digestive function

- Enzymes of succus entericus act on the partially digested food
→ Final digestive products.

Digestive enzymes of succus entericus

	Enzyme	Substrate	End products
Intestinal mucosa	Enteropeptidase “ ”	trypsinogen	trypsin
	Peptidases “, &...”	Peptides	Amino acids
	Sucrase	Sucrose	Fructose and glucose
	Maltase	Maltose and malotriose	Glucose
	Lactase	Lactose	Galactose and Glucose
	Dextrinase	Dextrin, maltose and maltriose	Glucose
	Trehalase	Trehalose	Glucose
	Intestinal lipase	Triglycerides	Fatty acids
	Nuclease and related enzymes	Nucleic acids	Pentoses and purine & pyrimidine bases
Cytoplasm of mucosal cells	Various peptidases . . .	Di-, tri-, and tetrapeptides	Amino acids

Proteolytic enzymes (Peptidases): They convert peptides into amino acids.

1. Amino peptidase.
2. Dipeptidase.
3. Tripeptidas.

N.B.: *Endopeptidase* “Cleave between residues in mid portion of peptide”

Amino peptidase “Cleave amino terminal amino acid from peptide”

Carboxypeptidase “Cleave carboxyl terminal amino acid from peptide”

Amylolytic enzymes

- 1-Sucrase.
- 2-Maltase.
- 3-Lactase.
- 4-Dexterinase.
- 5-Trehalase.

- Brush border enzymes of small intestinal epithelial cells
oligosaccharidases are responsible for the further digestion of the starch derivatives.

- Some of these enzymes have more than one substrate.

Sucrase, Maltase and Lactase convert disaccharides (sucrose, maltose and lactose) into two molecules of monosaccharides.

Dextrinase converts dextrin, maltose and maltotriose into glucose.

Trehalase or trehalose glucohydrolase causes hydrolysis of trehalose (carbohydrate present in mushrooms and yeast) and converts it into glucose.

Lipolytic enzymes:-

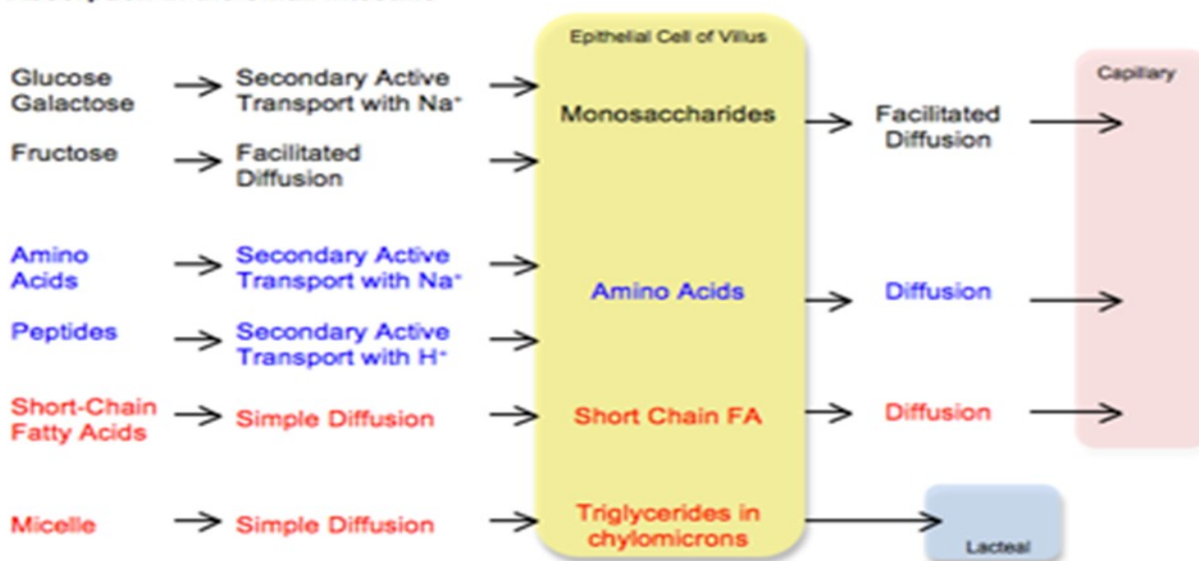
Intestinal lipase. Act on triglycerides → Fatty acids.....

II- Absorptive function

- Through small intestine wall, the nutrient will be absorbed into:
 - *Blood – water soluble nutrients
 - *Lymph – fat soluble nutrients
- Absorption in small intestine includes all of the following: Carbohydrates, Proteins, Fats, Water, Minerals, and Vitamins.
- Absorptive Function of Small Intestinal Mucosa depends on the presence of **A.** Large Surface Area & **B.** Specialized Transport Mechanisms
- High cell division of small intestine epithelial cells → Rapid replacement of epithelial lining → **A.** Increased enzymes → Improve digestion.
 - B.** Increased surface area → Improve absorption.

- Nutrient absorption in small intestine occurs by simple diffusion, facilitated diffusion, active transport, endocytosis,.....and paracellular transport

Absorption in the Small Intestine



Protein, Carbohydrate, Lipid and Nucleic Acids digestion and absorption in small intestine & Absorption of water, minerals and Vitamins in small intestine will be discussed in Digestion and absorption along GIT.

Other functions of succus entericus

Protective functions:

- Mucus present in succus entericus protects the intestinal wall from the acid chyme coming to it from the stomach. So, it protects against intestinal ulcers.
- Defensins secreted by the Paneth cells of intestinal glands are the antimicrobial peptide which called the natural antibiotics since they have a role in killing phagocytosed bacteria.

Activator function:

- Enterokinase present in intestinal juice activates trypsinogen into trypsin, which in turn activates the other proteolytic enzymes.

Hemopoietic function:

- Intrinsic factor of castle present in the intestine plays an important role in erythropoiesis “in absorption of vitamin B₁₂”.

N.B.: also known as gastric intrinsic factor (GIF), is a glycoprotein produced by the parietal cells of the stomach. It is necessary for the absorption of vitamin B₁₂ (cobalamin) later on in the small intestine.

Hydrolytic function:

- Intestinal juice helps in all the enzymatic reactions of digestion.

Some important hormones in GIT

Digestive hormones in the GI tract

HORMONE	LOCALIZATION	MAIN PHYSIOLOGIC ACTIONS
Gastrin	Gastric antrum, duodenum (G cells)	-stimulate secretion of gastric acid and intrinsic factor from parietal cells -stimulate secretion of pepsinogen from chief cells -promotes gastric and intestinal motility, mucosal growth
Cholecystokinin (CCK)	Duodenum, jejunum (I cells)	-stimulate gallbladder contraction -stimulates release of pancreatic enzymes -relaxes sphincter of Oddi for release of bile and enzymes -role in inducing satiety
Secretin	Duodenum, jejunum (S cells)	-stimulate secretion of HCO_3 from pancreas -inhibits gastrin and gastric acid secretion
Vasoactive intestinal peptide (VIP)	Enteric nerves	-increases water and electrolyte secretion from pancreas and gut -relaxes smooth muscles (via nitric oxide) of the gut
Gastric inhibitory polypeptide (GIP)	Duodenum, jejunum (K cells)	-reduces gastric acid secretion and intestinal motility -stimulates insulin release
Motilin	Throughout the gut (Mo cells and ECL cells)	-increases small bowel motility (MMC during fasting) and gastric emptying
Somatostatin	Stomach, small intestine, and pancreas (D cells)	-inhibits secretion and action of many hormones, including all of the above

Functions of Large intestine

1. **Absorptive function:** It plays an important role in absorption of various substances:-

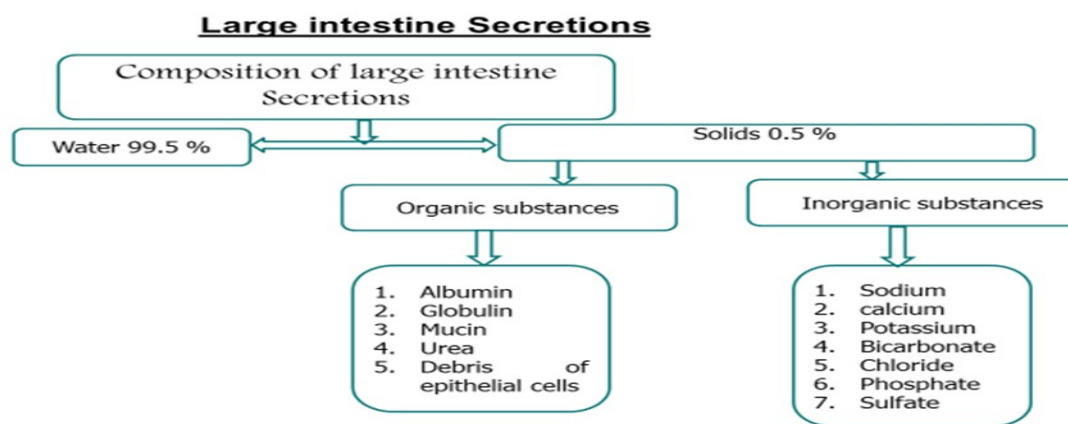
Water, Electrolytes (Na^+ , Cl^- ,.....), Organic substances like glucose, Alcohol, Drugs like anesthetic agents, sedatives, and steroids.

?? Vitamins produced by bacteria such as “.....”.

2. **Formation and storage of feces:** The unwanted substances after absorption form feces. Storage takes place especially in sigmoid colon “till time of evacuation”.

3. **Excretory function:** Heavy metals are excreted by Large intestine through feces e.g. mercury, arsenic, lead and bismuth. Also, bile pigments are excreted by large intestine.
4. **Secretory function:** Large Intestine secretes mucin and inorganic substances e.g. Potassium, chloride and bicarbonates.
5. **Synthetic function:** Large intestine bacterial flora synthesizes vitamin K, folic acid, and several members of vitamin B e.g. Vitamin B₁₂. So, it contributes in erythropoietic activity and blood clotting mechanism. Also, some bacteria produced important short chain fatty acids and participate in immune mechanism of the body.

N.B.: **NO digestive enzymes in large intestine secretion**



Functions of large intestine secretions

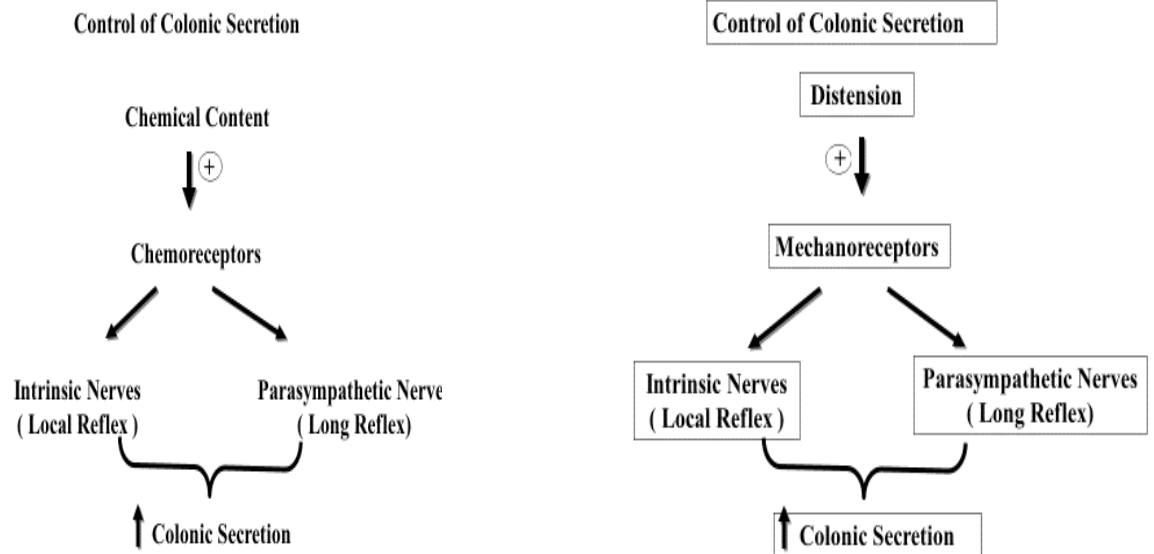
1. Neutralization of Acids:-

- Colonic **alkaline secretion** to neutralize acids produced by large intestine bacterial action. The alkalinity is due to large quantity of bicarbonates

2. Lubrication activity:-

- Secretion of **mucin** for protection of mucosal membrane from mechanical injury or chemical substances, lubrication of intestinal mucosa and bowel content → facilitate movement of bowel.

Control of large intestine secretions



SUGGESTED TEXTBOOKS

1. Ganong's "Review of Medical Physiology", 25th edition, Section V gastrointestinal physiology, Chapter 26, Page 464 to 473 & page 504
2. Guyton and Hall "Textbook of Medical Physiology", 13th edition, Chapter 64, Secretary Functions of the Alimentary Tract, from page 785 to 788
3. Sembulingam "Essentials of Medical Physiology", 6th edition, Chapter 41 from page 261 to 265 & page 279

New Five Year Program

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